Railway mechanical and electrical engineer

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AND

MECHANICS' MAGAZINE.

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For the American Railroad Journal and Mechanics' Magazine.

COST OF TRANSPORTATION ON RAILROADS. BY CHARLES ELLET, JR. CIV. ENG.

(Continued from page 362.)

I propose now to continue to produce those details of the cost of transportation on railroads, which enter into the approximate formula for the computation of the average annual charges, preparatory to the indication of certain modifications, which, in time, will be found necessary, in order to adapt the expression more strictly to the various cases which occur in practice. A reference to the table contained in a previous number of this Journal, (page 348) will show with what accuracy the formula, in its present state, applies to almost every variety of roads in the Union.

But it will occur to the experienced reader, that there are certain sections of the country on which the cost of fuel is exceedingly light; others where it is very great; that there are some lines provided with a double track; some on which the engines are unusually large, or on which the company are exposed to peculiar causes of expenditure. It will be readily conceded, therefore, that a formula *strictly* applicable to all these cases, ought to be expressed in more terms than the mere length of the line, the tonnage, the travel, and the miles run by the locomotive engines—which are all the quantities that appear in the rule which has been presented. But yet we have seen that that formula, as it is, does apply and give consistent results, and results quite close enough for almost any useful practical purpose, without any correction for these varying conditions. This circumstance, therefore, needs explanation; but before explanation can be advantageously offered, I must lay before the reader certain details which have been used in the construction of the formula. In anticipation of this explanation, however, I may observe that the true cause is, that these circumstances, which disturb the action of the general law, have very little influence compared with the value of the great items which compose the formula. I shall return to this subject again; but at present we may proceed with the determination of the values of the detail of expenses, and leave the slight corrections to be applied in conse-

quence of these irregularities—irregularities chiefly in the prices of labor and materials—for the sequel. The reports of the various companies for the current year, will shortly be published; and by introducing the results which it is to be presumed they will exhibit, under an improving system of economy, I hope to be able to make a still closer approximation to the truth. We shall have also, in a few weeks, the results of the year's operations on the Philadelphia and Reading railroad, from which we shall be able to verify experimentally, the influence on the cost attributable to a very large trade conducted under remarkably favorable circumstances.

I propose to consider next—

The Cost of Fuel.—It is obvious to every one that the *consumption* of fuel depends on the construction and power of the engine, the gradients of the road on which it operates, and the load which is conveyed. The *cost* of fuel really depends, in some measure, on these circumstances, but chiefly, in practice, on the *price* of wood; for in this country the price of a cord of wood is much more variable than any other element which affects the value of fuel, or the value of motive power.

The following table of the distance run by the locomotive engines in different parts of the country, together with the annual aggregate expense of fuel, and the reduced expense, per mile run, will serve to exemplify this point.

Table of the Expense of Fuel.

Name of Road.	Year.	Distance run by engines.	Expense of fuel.	Cost of fuel pr. mile.	Remarks.
		Miles.	*Dolls.*	*Cts.*	
Georgia road,	1842	152,873	6,405	4·2	South'n roads, average 5 cts.
Central road,	1842	102,145	4,810	4·7	
South Carolina road,	1842	260,324	13,950	5·3	
Portsmouth and Roanoke,	1842	96,000	4,700	4·9	
Petersburg road,	1842	131,160	8,200	6·2	
Baltimore and Ohio,	1843	509,765	33,447	6·6	Roads in middle States, average 9 cts.
Baltimore and Susquehanna,	1842	128,349	8,981	7·0	
Utica and Schenectady,	1841	155,828	11,000	7·1	
Philadelphia and Columbia,	1842	261,714	22,000	8·4	
New York and Erie,	1842	24,564	2,744	11·1	
Reading road,	1842	196,055	19,002	9·6	
Norwich and Worcester,	1842	144,321	14,662	10·2	New England Roads, average 13 cts.
Western road,	1842	397,295	50,774	12·8	
Providence road,	1842	120,000	17,546	14·6	

[NOTE.—The expense of fuel on the New York and Erie road includes the cost of sawing, and the loading of the tenders. The engines on this road, as well as a part of those on the Reading and Western roads, carry very heavy freight trains.]

On inspecting this table we observe that the cost of fuel for each mile travelled by the engines, increases very uniformly as we proceed from south to north. We know, also, that the price of wood likewise increases on the route, though not precisely in the same proportion. Wood is worth, on the

average, two and a half times as much in New England as it is in Georgia —but there are roads in New England on which the expenditure for fuel is from three to four times as much as it is on some of those of Georgia. This difference is not wholly attributable to variations in price, but depends, in part, on the size of the engines, and the magnitude of the trains conveyed. The engines on the southern roads, are, in general, not quite so heavy, nor so heavily loaded, as those used on several of the northern lines—a circumstance which somewhat, though not very materially, influences the result. Waiving the influence of this consideration, and regarding the engines as of nearly the same average weight on all these lines, this table will supply us at once with a correction to the formula, which we may apply when we desire to approximate more closely to the actual expenses.

The formula, for computing the aggregate annual expenses of a railroad, is based on an average cost of fuel of 9 cents per mile run.

In making the application, from year to year, we shall find that the results which it supplies will need to be modified, and that this modification will be equal to an addition of 4 cents per mile run for the New England roads, and a reduction of 4 cents per mile run for the Southern roads.

Wages of Train Hands.—It is the practice of many companies to include the wages of enginemen, firemen, conductors, breakmen, etc., in the item of fuel and salaries; of others to combine them with oil and repairs of engines and cars. Indeed, the heterogeneous mixture of items, which are presented to the public in a lump, cannot but lead sometimes to the conclusion that it is the object of the report to conceal the naked truth. It cannot be supposed that any company mingle such dissimilar items together in their own books; and as it is really easier to copy off the items under their separate heads, than to add them together and present them in a mass, it must be supposed that the object of the condensation of matter is to prevent an intimate acquaintance with their affairs. This inference is strengthened, in my estimation, by the fact that the accounts of those companies which pursue this course, exhibit an annual, and sometimes vast, augmentation of capital. By keeping the items concealed, the public are forbidden from ascertaining what portion of the ordinary current charges go to swell the annual charge to construction, and the deception is thereby practised longer with impunity. There are certainly some remarkable exceptions which might be named as good models for imitation. The accounts of the Georgia road are always presented with clearness and accuracy; and, though they might be greatly improved by the addition of the net and gross tonnage, and travel conveyed one mile, they exhibit, in their present state, a much better appreciation of the importance of knowing the precise and detailed condition of their business, than is observable in the statements of other similar institutions.

The report of the Baltimore and Ohio company, for the current year, also stands out conspicuous amidst the general confusion; and as ought to be

expected, *every item* of expenditure on that line compares advantageously with the same item on any other road in the country.

The directors of the Norwich and Worcester road in New England, have published a table which might be made valuable, but it is actually rendered almost useless for want of the amount of the business transacted. The number of tons of goods, and the number of passengers conveyed one mile, ought to have been stated, and the different classes of wages should have been separately given. It is of little use to tell us the exact amount of expenses incurred in the transportation of freight without informing us of the amount of freight transported.

The directors of the Western road have also presented much valuable detail; but they have failed to exhibit the item of "services" under appropriate heads. No correct judgement can be formed of the economy of the administration of a line on which the salaries of agents and superintendants, president and engineer, train-hands and wood-cutters, clerks and ticket-men, are condensed into one total. The separation of this column—the accurate addition of the number of passengers carried one mile, and the *quantities* of each sort of fuel consumed—would render the report of this company a most valuable document. I trust that they will not be detered from continuing this detailed exhibition of their affairs, when their road and machinery begin to manifest some of the effects of time and use.

In consequence of this mingling of items, I am unable to separate, with the desirable precision, the sum paid on many roads for wages to the engine hands, from that paid to the conductors and brakemen. For this reason I find it convenient to include the wages of all the train hands in the item of locomotive power. This item must, accordingly, be expected to vary with the magnitude of the train, and, somewhat, with the acclivities of the gradients: heavier gradients and the larger trains requiring usually a greater number of breakmen.

The variations consequent on this cause, are, however, very small; and we will come exceedingly near the truth by this formula,

$$7\tfrac{1}{2}+\frac{t}{25}$$

for the value of the wages to the train hands, in cents, for each mile travelled by the train—t standing for the average number of tons of freight in each train. The correctness of this approximation will be seen by a glance at the following table.

TABLE.

Name of Road.	Year.	Miles run.	Wages to train hands.	Wages per mile.	Remarks.
			Dolls.	*Cts.*	
Reading road,	1841	83,717	5,785	7·0	With moderate trains.
Reading road,	1842	198,055	17,752	9·0	With heavier trains.
Boston and Providence,	1842	132,229	10,799	8·0	Medium trains.
Baltimore and Ohio,	1843	509,765	31,161	6·1	Light trains and heavy grades.
Eastern road,	1842	184,127	14,774	8·0	Trains on both these roads are moderate.
Georgia road,	1842	152,873	12,666	8·3	
Petersb ırgh road,	1841	131,160	14,558	11·0	The Petersburg road was worked at disadvantage in 1840 and 1841. The freight trains on the New York and Erie road are unusually large.
New York and Erie,	1842	24,564	2,814	11·5	

The average value of wages, excepting for roads on which the trains are excessively large, may be safely and justly assumed at 8 *cents per mile run.*

Oil and Tallow for Engines.—The expense of oil is certainly a very small matter, when compared with the aggregate yearly charges against a railroad company; but it is a very important matter for every company to know exactly what this, and every other item of expense really is, and ought to be, in order to judge of the possible ameliorations of their management. On the Georgia road, in 1840, the mere greasing of the engines amounted to more than 4 per cent. of the aggregate charges of the company. In 1842, this item was reduced down to less than 1½ per cent.

As another example of the effect of the same sort of economy in the detail—in small matters—may be adduced the curious fact, that the sum paid for oil by the Philadelphia and Baltimore railroad company, in 1841, amounted to $6,131, and in 1842 it was reduced down to $2,151. In the year 1841 it amounted to 3½ cents per mile run, and in 1842 it scarcely exceeded 1½ cents per mile run by the trains.

The expense of oil is generally included under the head, "fuel, oil, salaries, general and incidental expenses, etc.;" "fuel, oil, salaries, wages, loading merchandize, and miscellaneous expenses;" "wages, fuel, oil, etc." This method of condensing accounts is so general, that out of the reports of more than thirty railroad companies for the year 1843, now on my table, I am able to select but the three following, from which the cost of oil, consumed by the engines, can be obtained separate from other items.

TABLE.

Name of Road.	Year.	Miles run by engines.	Cost of oil for engines.	Cost per mile run.	Remarks.
			Dolls.	*Cts.*	
Georgia road,	1842	153,873	1,411	9	Cotton waste is included in the charge on the Baltimore and Ohio, and believed to be included in that of the Georgia road.
Baltimore and Ohio,	1843	509,765	4,399	9	
Philad. and Columbia,	1842	261,744	3,104	1·2	Including oil for stationary engines.

This table would seem to justify the assumption of 9 *mills per mile run*, for the consumption of oil and cotton waste by the engine and tender alone.

There is to be found a considerable list of reports in which the aggregate consumption of oil by engines, tenders, and cars, may be separated from all other items. I have also some manuscript statements from which these items can be obtained. The following table exhibits the aggregate cost of oil for various lines, and the cost reduced to the mile travelled by the train.

TABLE.

Name of Road.	Year.	Miles run by trains.	Cost of oil for eng's & trains.	Cost per mile run.	Remarks.
			Dolls.	*Cts.*	
Central road,	1842	102,145	1,103	1·0	Light trains,
Reading road,	1841	83,717	1,621	1·9	Heavier trains,
Reading road,	1842	198,055	3,936	2·0	Still larger aver. trains,
South Carolina road,	1842	260,324	2,784	1·1	
Utica and Schenectady	1841	155,828	3,500	2·2	Not strictly accurate,
Philad. and Baltimore	1842	177,859	2,151	1·2	Chiefly passe'g'r trains,
Georgia road,	1842	153,873	1,821	1·2	Trains equal preced'g,
Norwich and Worces.,	1842	144,321	1,947	1·4	Wei't of trains unkn'n,
Western road,	1842	397,295	9,215	2·3	Heavy trains,
New York and Erie,	1842	24,564	481	2·0	Heavy freight trains,
Baltimore and Ohio,	1843	509,765	7,201	1·4	Lighter trains.

The consumption of oil and tallow may be estimated, in general, at 9 mills per mile run for the engine and tender, and an additional allowance of $\frac{1}{4}$ mill for each ton net conveyed one mile.

I have also the consumption of oil and tallow for some other lines, but as these statements manifest great and censurable extravagance, and cannot be used to show the necessary expenditure on a well conducted road, I have not included them in the preceding list.

Sawing Wood, Pumping Water, and Loading Tenders.—It is not easy to collect facts which will exhibit the actual cost of the items included under the present head for many roads; but it is very easy to estimate their average value by direct calculation. We know that it is worth, on the average, about 40 cents per cord to saw the wood suitably for this purpose: and we know also that a cord of wood is sufficient to supply the consumption of the engine while running about 40 miles. It is, therefore, worth *one cent per mile run*, to cut the wood for this purpose. To load the tenders, where the business is regular and great, is worth about 20 cents per cord, or *a half cent per mile run.* The cost of raising the water depends more on the conveniences afforded by the situation. If we assume the average lift at 30 feet, the labor of a man will be equal to raising about 40,000 pounds per diem. Engines usually consume from 300 to 400 pounds of water per mile run, which brings the cost of pumping to about the $\frac{1}{110}$ of a day's labor—or about 8 mills *per mile run.* These items make together $2\frac{1}{2}$ cents per mile run.

The result of experience for two roads is given in the following

TABLE.

Name of Road.	Year.	Miles run by engines.	Cost of sawing loading and pumping.	Cost per mile.
Boston and Providence,	1842	120,000	$3,266	2·7
Philadelphia and Columbia,	1842	261,774	5,989	2·3
			Average,	2½ cts.

Locomotive Power.—We have now gone over the items in detail which compose the cost of locomotive power, and are, therefore, prepared to sum them up, and compare the aggregate of the averages with the amount at which it is stated in the formula, proposed for the computation of the aggregate annual expenses. These items are

	Cents.
Repairs of engines and tenders per mile run, - - -	7·0
Fuel per mile run, - - - - - - - -	9·0
Wages of train hands per mile run, - - - -	8·0
Oil for engines and tenders, per mile run, - - - -	0·9
Sawing wood, loading tenders, and pumping water, per mile run,	2·5
Cost of locomotive power per mile run, - - - -	27·4

It will, of course, be recollected that this result is independent of the injury to the road, which we have considered under the usual head of "extraordinary expenses."

The only division of these expenses which is liable to material variation, is the cost of fuel, the price of which varies with the localities. I have already offered an approximate correction of this item, which may be employed for general investigations; and shall shortly take occasion to present a more accurate formula for its computation, based upon a very extensive experience.

It might seem to the general reader, that after presenting the cost of repairs of the road, engines and cars; the value of fuel and wages of train hands; the consumption of oil, and the injury to the iron, that there would remain but little more to adduce in the premises; but I have yet a very important division of the subject to discuss, which is much too frequently overlooked in investigations of this character.

There are other extraordinary expenses, and certain contingencies which go far to swell the annual charges on every line—without any exception in behalf of the most favorably situated, or of those which are most economically administered.

I proposed, in a former article, to offer an estimate of the probable expenses on a railroad in active operation for the present year, which is now the object of much attention and interest, in order to exhibit an application of the formula in anticipation of the publication of the company's next report. I take the Philadelphia and Reading railroad for this purpose; and assume that it will this year give transit to 250,000 tons of freight, and 40,000 passengers. The application of the formula to this work—making proper allowances for its gradients and drawbacks, and facilities for unloading, and hav-

ing due respect to its age—will produce for the aggregate expenses, the sum of $265,000.

This estimate, of course, refers only to the apparent expenses, and includes no part of those reserved charges—such as the wear of iron—which are usually denominated "extraordinary expenses" because they are not generally of annual recurrence. The durability of iron rails I assume at about 800,000 tons—while they are estimated by the enthusiastic friends of the Reading railroad, at 12,500,000 tons. Where such immense differences exist, time must decide the question. I trust that time may not show that I, even, am too sanguine and expect more from the railroad system than it is capable of rendering.

(To be continued.)

NOTES ON PRACTICAL ENGINEERING.—NO. 4.

Bridges.

In looking back at the different kinds of bridges which have been built during the last ten or twelve years, it is obvious that there is a fashion which rages for a certain time when some particular bridge is generally adopted for new structures, but which soon falls out of use and is succeeded by another temporary occupant of public favor.

Lattice bridges were much in vogue some eight or ten years since and were very extensively introduced on railways. Where the span does not exceed 100 feet and where the roadway can be carried on the top of the framing so as to admit of vertical transverse bracing, this plan does very well. There is, in Weale's bridges, an engraving of one of these structures similar to the bridge over the Hudson at Troy, built with double lattice and for a double track with suspending posts in the middle. The span at Troy is 180 feet and the bridge is by no means stiff. The same remark may be applied to a similar bridge of about the same span on the Harlem railway. These bridges require very good horizontal bracing to keep them in shape, they must be weather boarded, they require a large quantity of timber and they burn with a rapidity almost incredible. Thes disadvantages have been the means of banishing them from railways in this country though an English engineer introduced them on a railway in England only a few years since.

A very ingenious modification of this bridge was devised by Mr. Haupt, of Philadelphia and an account of it with a sketch of the bridge was published in this Journal.

Col. Long's bridge is very well known throughout the Union. It is a good specimen of carpentry, is very stiff, does well without boarding in, but after a few years the pressure of the braces splits off the shoulders of the posts against which they abut, that is if the posts nearest the abutment, the pressure of course diminishing towards the centre of the span.

In order to obviate this difficulty, Messrs. Hazard & Co., contractors, introduced a set of braces radiating from the abutment to the head of each post, or rather pair of posts, and occupying the space allotted to the counter

brace in Long's bridge. Numerous structures of this kind have been put up and are well spoken of.

Another contractor, Mr. Howe, designed and erected the railway bridge over the Connecticut at Springfield in which iron rods supply the places of the posts; the braces, which are of timber, cross each other in the style of lattice work. There are, however, two braces and one counter brace, the vertical rods passing on either side of the latter. There is perhaps less work on this bridge than on any other, and the braces and rods may be very easily replaced. It is not screwed in. The wood work of this bridge is a sort of compound of the bridges of Town (lattice) and Col. Long.

The architectural effect of these different bridges is what might be expected from an enormous square box and, whether boarded in or not, may be safely put down as a minimum. They all avoid the arch, which adds so much to the strength of Burr's bridge, a structure which the writer has generally found deficient in stiffness, though it is proper to say that his acquaintance with it is less extensive than with others. Although generally roofed and boarded in, the arches take off something of the dull rigid outline by running beneath the floor at the haunches. Where, however, floods approach the floor of the bridge, this springing of the arches lower down on the abutment is obviously attended with inconvenience and even danger in some cases.

In short spans it will be generally admitted that the old plan with two queen posts and good iron straps is the cheapest and at least as good as any other. For common road bridges, this mode of construction has been used in spans of considerable length and is applicable to railway bridges at least as far as 50 feet. It is a good plan to carry iron rods from the ends of the braces and straining beam near the head of the queen post down through the strings, instead of merely passing them through the strings or tie beam and bolting them to the lower end of the queen posts.

Indeed too little iron has been used in many American bridges, and although Dr. Robison says, "a skilful carpenter never employs many straps, considering them as auxiliaries foreign to his art," the experience of this country in lattice bridges, Long's bridges and others where reliance has been placed on the lateral cohesion of the fibres in the shoulders of the posts in Long's and Burr's plans, and on the close fit of the pins in lattice bridges, would appear to indicate the propriety of introducing a greater quantity of iron as well as bestowing greater attention on the dimensions and minor details—as heads, washers, threads—than has been done in many instances.

In looking at the various parts of an English wooden bridge, an experienced eye sees at a glance that no labor has been spared on details; that the minutiæ have deen carefully weighed even in designing a bridge 5 or 6 feet wide to enable the horses to cross a canal. Although their comparative durability cannot well be known, it must be admitted, that with the same quantity of material and but little if any more labor in the construction, they present an appearance of neatness, finish and adaptation to the object aimed at,

which will be found in very few American wooden bridges. It would, however be unfair to the American engineer to stop here. It is unfortunately the custom here to give a preference—in the case of road bridges—to some builder or contractor, often a patentee of some plan infinitely more ingenious than judicious, over the educated and experienced engineer, whose promises, before the commencement of a work, fall as far short of those of his rivals as his actual performances exceed the crude and almost invariably more costly productions of these people.

Now the English bridges with which we become familiar through the various publications of the day, are all or nearly all designed by members of the profession or persons well qualified by education, experience and character, and the result is precisely what might be expected. In the case of stone arches on some American railways, the design and execution of the work would confer credit on any engineer in any country, but such opportunities are of rare occurrence. This very circumstance shows what might be expected from the profession in this country were arches of stone more generally adopted, and the excellence, abundance, and almost infinite variety of the material must at some future day cause many of the smaller streams to be adorned with these unrivalled structures. Many wooden bridges on railways are brought down by the grade of the line as near as possible to high water mark, hence there is comparatively little opportunity for architectural effect in such cases. With road bridges this is not generelly the case, and a rise of a few feet in the centre of the span is no objection. There is a very good specimen of a road bridge in the Civil Engineer and Architect's Journal, vol. I, p. 177, and all must recollect the elegant and graceful "Pont du Carousel" by M. Polenceau, constructed of cast iron and timber, a combination which may be introduced in an endless variety of ways and proportions, and which the great improvement in the quality and the gradual reduction in the price of American castings renders well worthy of our attention.

New York, Dec., 1843. W. R. C.

For the American Railroad Journal and Mechanics' Magazine.

I have read with some surprise a series of articles which have appeared in the Journal on the "Cost of transportation on railroads, by C. Ellet, Jr. C. E." Had the statement been perfectly correct and Mr. E. had succeeded, as I do not doubt he has, in producing a formula which will come within 12 per cent of the expenses from the known business on any particular road, I am still to learn to what use it can be applied. My object, however, at present, is not to discuss the formula but to correct some gross mis-statements which have appeared in the last two articles, in relation to the South Carolina railroad, and then leave your readers to judge how much confidence is to be placed in what he says of the other roads. If what he advances in relation to the cost of renewing the iron on railroads be true, railroad companies cannot too soon get rid of such unprofitable property.

In his comparative statement of the actual and calculated expenses of the South Carolina railroad for 1842, the through tonnage is put down at 27,-

000, and through passengers at 24,000. The income from freight during that year was $192,823, which divided by $8, about the charge for transporting a ton over the road, gives 24,000; and the receipts from passengers for the same time were $127,684, and this divided by $8, the charge for a through passenger, gives for the total through passengers 16,000. The expenses calculated by the formula for 24,000 tons and 16,000 passengers, will be $200,500, in place of $214,000, or an error of 12 per cent. in place of 5 per cent. In the same statement, the expenses of the Western road are quoted at $256,619, in place of $266,619, as stated in the company's report, or an error of 4 in place of 0.

To the statement of the cost of repairs of engines on the Georgia railroad, Mr. E. appends this note—"This company have added to the usual division of their expenses into ordinary and extraordinay repairs, the new classification of 'improvements to engines;'" not being able to conceive that a small stock of engines could run 153,000 miles and be materially improved by it, I regard these "improvements" as expenses. I cannot conceive how any stock of engines could be improved by running 153,000 miles; neither do the Georgia railroad company say that theirs were, but they do say that two of their engines were improved by expending $950, in substituting "small driving wheels and large cylinders" for "large driving wheels and small cylinders," and that these and other improvements have enabled them to dispose of one of their "small stock" of 12 engines. Moreover, the company have charged these improvements to "cost of repairs of engines," and have not, as they might have done, credited the "cost of repairs," with the proceeds of the engine which these improvements enabled them to part with.

Mr. Ellet says, "the first iron used on the South Carolina road was destroyed in less than six years—after it had borne about 130,000 through tons and 120,000 through passengers, and the locomotives had made 10,000 through trips." The iron was *destroyed* in less than six years! The company in their report of November, 1833, state that the iron delivered on the road cost $109,453 80; in their report of July, 1841, and in all their subsequent semi-annual reports, there is credited to cost of construction "*old iron sold* $92,321 75," the sum which was received for 1,800 or 2,000 tons, three-forths of the original weight. From this it will require no prophet to inform Mr. Ellet that the iron which originally cost the company delivered on the road, $40 per ton, was sold by them for nearly $50! after it had been "destroyed in less than six years." Of the remainder of the iron, a large portion still remains in the depot tracks and turn outs on 136 miles of road, little short, I should suppose, of 10 miles; much has been used in the work shop in the construction and repairs of locomotives and cars, and many other purposes; and lastly, some of it was loaned to the contractors for earth work on the Louisville, Cincinnati and Charleston railroad, and bore a transportation of 40,000 or 50,000 cubic yards of sand and hard pan, equivalent to eighty thousand tons besides the cars, (as some of the contractors, much to their sorrow, can testify,) or more than one-half the tonnage which was

sufficient to destroy it, and this, mind you, after it had already been destroyed, and what is quite as wonderful, the company were foolish enough to receive it back again without making any charge for the use of it, considering that it had not been materially injured. Here, at least, is *one* iron rail that could not be considered "bad." From what I have here stated, I think it will not be a very unfair conclusion to draw, that the iron which "was destroyed in less than six years," afterwards brought the company in cash, and in other shapes, as much as it originally cost them delivered on the road; and that in this case,

$$a\ N+b\ T+c\ P=0.$$

This may be no exception to the rule, but like the engines on the Worcester road, is certainly a case in which the formula does not apply. Trusting that your correspondents will furnish you with sufficient authentic data to come within $1,000 of the value of the above expression, I will conclude these remarks with the following quere. Recollecting that "*the destruction of the* T *or* H *rail will be greater*" than that of the plate rail, in other words, the heavier the rail the faster it wears, if a plate rail weighing 12 or 13 lbs. per yard can bear the transportation of 80,000 tons after it has been *destroyed*, without being materially injured by it, how much can be transported over a rail weighing 60 lbs. per yard, (like that on the Reading road) without rendering it unfit for use? Q.

BALTIMORE AND OHIO RAILROAD REPORT FOR 1843.

For this report, as for many other favors, we are indebted to Mr. B. H. Latrobe, the chief engineer, who will please accept our thanks.

From this report we learn the following facts, viz:

1st. That on the main stem the rates were reduced on passengers 25 per cent., and on tonnage 30 per cent.; and that the number of passengers has more than doubled, and the tonnage nearly doubled; while on the Washington road the number of passengers has fallen off 17 per cent, and the tonnage 8, where the rates were *not* reduced, notwithstanding the roads south of Washington materially reduced their rates, and thus gave this road the benefit.

2nd. That the *cost* of transportation has been reduced on the main stem, on feight, *fifteen* per cent., and on passengers *fifty-six* per cent.; while on the Washington road the cost of working the road, during the past year, with a *reduced* business, is only $46 less than the previous year.

3d. That the excess of nett revenue, on the main stem, this year over the past, is on passengers $93,440, and on freight, $55,401; while the nett revenue on the Washington road is less than last year. It is to be borne in mind, however, that the extension of the main stem to Cumberland has mainly, or largely, contributed to this increase.

The report shows an encouraging state of affairs, and calls loudly on the citizens of Baltimore and of Maryland to push forward this important work, and we hope to learn soon that efficient measures have been adopted for extending the road to the Ohio river.

We have watched, with deep interest, for nearly fifteen years, the progress of this work; and it is nearly twelve years since the reports of the company were published in this Journal, and although exceedingly anxious to examine the work, yet, not until the past summer was the writer able to visit and pass over it, though frequently invited so to do. In June last, while on a short visit to the monumental city, we availed ourself of a polite invitation from the chief engineer to accompany him over the road to Cumberland, which afforded us an opportunity to form a better idea of the labors performed by this pioneer company. It has truly been a herculean work, especially when we consider the difficulties to be surmounted, and the limited experience in relation to the construction and working of railways when it was commenced. But the main difficulties are overcome, and the vast importance to Baltimore of its speedy completion are becoming daily more evident and of course renewed efforts will be made this winter to provide the means for prosecuting the work vigorously next season; and it is to be hoped that the citizens of Baltimore, who have done so much in the cause of railroads, may, at an early day, derive all the benefits which they have anticipated from this noble work.

With the facts contained in this report before them, it is to be hoped that the legislature of Maryland will adopt measures authorizing the company to reduce the fare on the Washington road, in accordance with the spirit of the times, and thus increase the profits next year. Of *one* result they may rest assured, and that is, that if they do not reduce their rates, the *travelling community* will avoid this road, when they can do so, and *thus* reduce their income. It is a fact now well established, that in *most* cases, where the rates have been reduced, the travel has so increased as to augment the *nett revenue*; and it will be so on this road, we have not a doubt, as it would be between New York and Philadelphia by a reduction of the fare to $3, or even to $2 50—which we hope may soon be done.

At a meeting of the stockholders held pursuant to the charter, on the second Monday of October, 1843, in the city of Baltimore, the president and directors of the Baltimore and Ohio railroad company submitted the following report and statement of the affairs of the company:

In the last annual report it was stated that the road would be completed to Cumberland between the first and tenth of November, 1842. It was accordingly opened on the fifth of the month, and has ever since been in operation from that point; thus accomplishing another, and by far the most important step towards the extension of this great work to its final destination.

The new part of the road west of Harper's Ferry may be said thus far to have answered the expectations of the board; and, independently of the necessary expense of keying up the bridges, requiring an inconsiderable expenditure in the adjustment of its parts.

During the past season, however, many parts of the country between Harper's Ferry and Cumberland have been visited with several freshets of unexampled power; the water suddenly rising on two occasions some feet higher than was ever before observed; and either sweeping away or materially injuring various works and descriptions of property throughout the country, which had successfully withstood all previous floods.

At three points within three miles of Harper's Ferry, one of the freshets did considerable damage to the railroad, by carrying away three of the culverts and portions of the embankment. At one of the culverts near the Little Cacapon, some slight damage was also sustained. The injuries, however, were temporarily repaired with such despatch as that the travel was interrupted over those parts of the road for a few hours only, and the transportation of burthen for not more than three days.

To repair permanently the damage, and to place the culverts beyond the reach of even a higher rise in the water, may be expected to increase the expense of repairs in the current year about $15,000, being upwards of $2,000 less than the surplus on hand from the year just ended.

All the other part of the road withstood without injury the force of these unexampled floods; and their strength may be considered sufficiently tested to inspire new confidence in their future stability.

In consequence of the opening of the road to Cumberland, and upon the commencement of the spring trade and travel, the charges for transportation, both of passengers and merchandize, upon the Pennsylvania lines were considerably reduced, and throughout the year have been kept at rates which it is believed are not required by the public nor justified by the true interests of the works. Nevertheless, to meet such competition, and to enjoy any share of the trade, it became necessary that the board should reduce the charges upon the Baltimore and Ohio railroad; and they were accordingly reduced, for passengers about 25 per cent., and for tonnage about 30 per cent. below the rates of the previous year. For some time after the opening of the road to Cumberland, the difficulties of wagon transportation over the National road, both as to capacity and rate of charge, also interposed serious obstacles to the trade upon the railroad; and these it will not be possible wholly to surmount until the road can be extended to the Ohio river.

Notwithstanding these impediments, the operations of the road between Baltimore and Cumberland since the 5th of November, 1842, have been altogether encouraging, fully warranting the expectations which urged its completion to that point; and calculated to inspire the stockholders and the board with renewed zeal in their future exertions to carry it onward.

The statement B exhibits the revenue and expenses of the main stem during the year ending on the 30th of September.

It is deemed proper also on the present occasion to submit a tabular statement, prepared by the engineer of machinery and repairs, exhibiting in detail the operations and various actual expenses incident to the working of the main stem during the year, together with the amount of receipts from all sources during the same period.

These statements exhibit a gratifying augmentation in the trade and travel upon the road; and as proportioned to the work done, a continued reduction in the cost and expenses of transportation.

The excess of revenue for the past over the preceding year, for passengers, is $93,440, and for tonnage, $55,401, amounting together to $148,841.

The nett earnings of the main stem, independent of the Washington road, over and above the expenses of working the road, amount to the sum of $279,401 55, being equal to 4 per cent. upon the capital.

The railway east of Harper's Ferry has been considerably improved, both in adjustment and material during the year; and that west of the same point, with the exception of the injuries already mentioned, is in better adjustment than at any time since it was opened.

During the year, one new engine has been added to the moving power, and another will soon be placed upon the road. The entire complement

will then consist of twenty-eight locomotives; and the present business of the road will require, upon the average, at least twenty-two to be in actual daily operation. It is not doubted that in the present state of efficiency, the moving power will be adequate so an increase of at least fifteen per cent. upon the business of the past year.

The passenger and burthen cars, and the depots and water stations are in good condition. There are also on hand duplicate parts of machinery, and a stock of materials for general repairs, and for the construction of burthen cars, exceeding those of any previous year; amounting in the aggregate to more than $40,000. As a general result from these statements, and the operations of the year, it may be stated that during the past, as compared with the preceeding year, the number of passengers transported one mile has been more than doubled, and the amount of tonnage nearly so; that the cost of transportation of passengers has been fifty-six per cent., and of transportation of tonnage fifteen per cent. less than in any previous year; and that if consistent with the competition with other works the board could have maintained the original rates of charge, with the same economical cost, an equal amount of business would have yielded a nett revenue of little less than seven per cent. upon the capital employed.

The board having reason to believe that their present power might be beneficially employed in the transportation of coal from Cumberland to dam No. 6 on the Chesapeake and Ohio canal, to be carried thence by the canal to the District of Columbia, have consented, upon the application of the canal company and others, at present to fix the charge upon coal between those points, at two cents per ton per mile; and will be ready as soon as the canal may be navigable, to engage in the transportation of that article upon these terms. The present rate is of course fixed with reference not only to the quantity offered for transportation, but to the permanence of the trade.

With a satisfactory assurance that the business would be permanent, the company might engage in it at a less charge than two cents per ton per mile, on any part, or for the whole extent of the road. The board, however, would not be justified in the expenditure of a large sum to augment the moving power and provide machinery not adapted to other purposes, if upon the completion of their preparations, they might encounter competitors even at no lower rate of charge.

All debts due from the company, and not in dispute, during the past year, including $50,000 of principal and 23,355 of interest to the Messrs Baring, under the arrangement for the iron rails communicated to the stockholders in the last annual report, have been discharged; and those remaining unpaid do not in all exceed the sum of 40,700 dollars.

The nett revenue of the main stem (including the sum of $46,467 received from the Washington road) after payment of the foregoing debts, amounts to 172,479; of which the board have determined to appropriate $15,000, according to the pledge in the last annual report, as the commencement of a sinking fund on account of the loan of $1,000,000, for the Washington road.

Of the ballance they have determined to divide among the stockholders $2 upon each share of stock, payable on and after the 1st day of November next, reserving a surplus of 17,479.

Before passing from the accounts of the main stem, the board deem it proper to remind the stockholders that in the operations of the past year, they have not only encountered the competition and impediments already adverted to, but have been exposed to the heavy charge incident to the employment of horse power in the introduction of passengers, as well as burthen, into

the city. The amount of such charge, with the present travel, may be estimated at from 12,000 to $15,000 annually. It must of course increase in proportion to the augmentation in the number of passengers, unless the present system be abandoned, or the city authorities should think proper to permit the introduction of the locomotives; as is now permitted in some other cities, and partially in Baltimore, without injury or inconvenience.

The nett earnings of the Washington road for the year ending on the 30th September, 1842, authorised a dividend of five dollars per share, and left a surplus of 8,834 40.

The nett earnings for the year ending on the 30th ultimo, are 61,691 46, which added to the surplus of the preceding year amount to $80,525 86, of which the board have decided to divide among the stockholders four dollars and fifty cents per share, payable on and after the 1st day of November next, retaining a surplus of 6,275 86.

From this it will be seen that during the past year the company have paid on account of the subscription to the Washington road $13,533 more than they have received from its earnings.

The sum paid to the State for the six months from the 1st of January to the 1st of July, 1842, being one-fifth of the gross receipts from passengers amounted to 20,500 26, and from the 1st of July, 1842, to the 1st of January, 1843, to 18,125 69, together $38,625 95. The amount paid to the State on the same account for the half year from January to July, 1843, was 15,439 88 dollars.

It is also to be remarked that if the sum of 33,565 57, paid to the State on the 1st of January and 1st of July, 1843, the one-fifth of receipts from passengers, there be added the sum of 24,750, the dividend of the Washington road, 10,000 from the main stem, and 1,269 60 regularly remitted by the board to London as the interest upon $5,250 sold of the subscription of $3,000,000, it will appear that the State has received during the year the sum of $69,585 17, being nearly seven per cent. upon her entire actual investment in both roads.

The railway, the passenger and burthen cars, and depots and water stations of this road are in good condition; and the expenses of repairs, and cost of transportation in the aggregate vary in a small degree from those of the preceding year. The aggregate value of materials on hand for repairs of railway, locomotives and cars may be estimated at 5,900 dollars.

A comparative statement of the operations upon the Washington road during the past and preceding year, is appended to this report.

It shows that, although the cost of working the road in both years has been nearly the same, the falling off in passengers has been at least 17 per cent., and in tonnage about 8 per cent.; and, consequently, that the diminution in the revenue is mainly, if not wholly, attributable to a decrease in the passenger travel. Such result was apprehended last autumn as likely to arise from the cheaper competition by the bay line of boats from Baltimore to Norfolk; and a application was made to the legislature, at the last session, by parties concerned with the southern portions of the inland route, to authorize a reduction of the charge for passengers on the Washington road. The application proved successful; and although this board thought the apprehension well founded, and concurred in the justice and propriety of co-operating with the southern companies in a fair reduction throughout the line, they had no power to alter the rate of charge for passengers between the two cities, or to bear any proportion of a reduction by others, without the authority of the legislature, or, in the recess, of the Governor of the State.

The charter also makes it lawful for the legislature, upon the application by the railroad company for any reduction in the established rate, so to regulate the charge as without reducing the proportion of one-fifth at present reserved to the State, in fact increase it, and reduce only the share of the company.

Unwilling to expose the interests of the stockholders to the operation of this provision, the board declined preferring any direct application. They, however, caused a communication to be made to the Governor on the 2nd of August acquainting him with the actual falling off of the business of the road, subsequent to the adjournment of the legislature, and calling his attention to the causes which it was supposed had contributed to it. To this letter an answer was transmitted by the secretary of State on the 5th of September, acquainting the board that, in the opinion of the Governor, the charter authorized him to consent to a reduction of charges for temporary objects only, without power to provide for the case to which the company had called his attention; and that, besides, he did not feel justified in interfering in the present instance, inasmuch as the legislature at its last session, had the whole subject under consideration and did not think proper to act.

It is proper to add that without the co-operation of this board, some of the companies connected with the inland route, in the course of the summer, reduced the charges upon their respective lines; and that subsequently there has been an evident improvement in the travel.

We omit, for want of room, the argument of the president in favor of vigorous measures being adopted to complete the road to the Ohio river. We may add, however, that it is, as might be expected from the able man at the head of the company, directly to the point.

The application of the power of steam upon the water and on land has already produced incalculable effects throughout the world. It is of too ready adoption, and too successful in operation to escape the attention of any enterprizing community; and all who expect to acquire superiority or maintain equality in agriculture, commerce and manufactures must rely upon its aid. *They must embrace the remotest points by the shortest distance and at the least cost of transportation.* Nature has placed the city of *Baltimore* within the shortest geographical distance of the trade of the western country; and any proper connection she may form with the Ohio river becomes as matter of course and above all competition, the direct and cheapest channel of communication, not only with the intervening country, but with the entire vallies of the Ohio and Mississippi rivers.

The growth and prosperity of any of our Atlantic cities depend upon the extent of foreign and domestic trade which they may be able to command; and these again require the facilities of a certain market, reached at the least cost, and offering the best prices.

To regain her former advantages, Baltimore must resort to the same artificial power by which they have been superseded—as stated in the last annual report, she must unite the power of steam on land with that on the water, from New Orleans to this city.

The successful operation of finished railroads judiciously located and economically managed between desirable points, is satisfactorily established by experience both in the United States and in Europe; and that a railroad from Baltimore to the Ohio river, comprehends the most important intercourse between the various parts of the Union will not be denied. While the considerations which in a public point of view, warranted the original enterprize have lost none of their importance, the board venture the opinion that the

capabilities of the work, and the claims it prefers to the public favor are already fully established. Wholly and peculiarly calculated to improve the trade and augment the wealth of every part of the State, they must continue to regard it as one of chief magnitude.

It is not to be disguised that many portions of the State, already heavily taxed for the maintenance of public credit, have little interest in any public work beyond what they incidentally derive from the prosperity of the commercial emporium; and if the Baltimore and Ohio railroad can in any sense be deemed a rival of any other enterprize, it can only be from its tendency to concentrate in the Maryland market the resources which by different channels would be diverted to other cities.

Already, in its unfinished state, it has imparted a new impulse to the trade and capital of the city of Baltimore. In the first year of its extension, after little more than ten months operation from *Cumberland;* subject to the rivalries of the works of other States at reduced rates of transportation, and without aid from the Washington road, it has earned a nett revenue of four per cent. upon the capital employed; and had it been extended, would have needed no greater amount of trade at prices which might have been charged without inconvenience, to have earned at least seven per cent.

Fully impressed with the necessity of making every exertion for the further prosecution of the work, it is a source of regret that, from causes beyond their control, the board have been unable during the past year to adopt any efficient measures for that purpose. The charter of the company both in Maryland and Virginia, by its original terms, is perpetual; but without additional legislation, the board had no authority, after the 4th of July last, to occupy any greater extent of the territory of either State for the extension of the road. Although the legislature of Virginia adjourned without removing this obstacle, the board have reason to believe that at the ensuing session an application for that purpose will be more successful.

In Maryland, the legislature allowed a further period of twenty years; but at the same time incorporated the permission in the law authorizing a sale of the public works, and in such manner as that, unless the State's interest in the work should be sold, the authority could not be exercised.

The board would not be unwilling to co-operate with the legislature in any equitable disposition of the State's interest in the railroad company; as a means of lessening the public debt, and to that extent effecting some immediate relief to the people from the burthen of taxation.

By the terms of the late law, however, there were grounds to apprehend that the period of twenty years would operate as a limitation, not upon the completion of the work only, but upon the duration of the *charter;* and that, notwithstanding the guarantee of a perpetual annuity of 30, 000 dollars from the Washington road, the State would also be entitled to receive, in addition, one-fifth of the gross receipts from all passengers passing over the road to and from the city of Annapolis.

Under these circumstances, if in any other respects it had been objectionable, the board did not feel warranted in recommending the law to the acceptance of the stockholders.

From these causes, the board have been constrained to limit their measures for the extension of the road, to further reconnoissances of the country west of Cumberland through the State of Virginia, in the well founded belief that in that direction, should it become advisable to seek it, a better and cheaper route to the Ohio river may be obtained.

They also look forward with confidence to more auspicious legislation in both States during the ensuing winter; and it is their intention in that event,

in the same spirit which has animated them in the past, to take such measures, as with the resources adverted to in the last annual report, may enable them to recommence the prosecution of the work committed to their management. By order of the board, Louis McLane, *President.*

For the American Railroad Journal and Mechanics' Magazine.

To the Editors—Gentlemen—I have prepared, and respectfully submit, through your paper, to the consideration of the several railway companies of the United States, the accompanying form of a statistical table, intended for an annual exhibition of the character, cost and operation of their respective works. The collection and arrangement of railway statistics has heretofore met with serious obstacles in the irregular and incomplete manner in which most railway reports are presented to the public. Many details, essential to the derivation of general principles and practical results from the actual working of the railway system, are altogether wanting in their reports, and those particulars which are given, are often expressed and arranged so as to be useless, or available only at the expense of much time and labor. Believing that all railway companies would desire to make their reports as useful as possible, I have taken the liberty of proposing the present formula as a guide, which, if universally followed, will be eminently advantageous to them all individually; for each will have its contribution to the capital of knowledge, thus built up, repaid an hundred fold by the shares contributed by the rest. The value of this aggregation of the experience of the country, in this department of its institutions, will be incalculable.

I suggest, that in addition to the publication of this in the Journal, the tabular form be printed on a loose sheet, and sent forthwith to each railway company; and, thereafter, annually, a convenient time before the period of the publication of its annual report. The expense of this will be trifling to the Journal, to which most of these companies subscribe. Should any of them not see fit to attach the table to its annual report, they may perhaps be nevertheless willing to fill it up and let it appear in the Journal. Upon receiving all the tables from the several companies contributing them, a general table could be made out under the same heads, in which the contents of all the individual statements would be contained.

In the preparation of the form submitted, I have embraced elementary facts only, the proper deductions from which can be drawn by calculation. It is believed that no element, necessary to the knowledge of any important particular, respecting the work which may be under consideration, is omitted, while, at the same time, the companies furnishing the facts are asked for no more than is essential, as premises, to the conclusions which every one interested will draw for himself. The arrangement of the table may not perhaps be the very best, although it seems to make the most of the space included within the outlines. This is a matter of minor importance. The relative positions of the columns can be shifted to suit the judgment or taste of the party concerned. It is hardly to be expected, that the whole of these columns can or will be filled by all railway companies, some of which may

not have so kept their accounts as to render so minute a subdivision practicable. In such cases, approximations might be made which would answer the purpose, or, if these are out of the question, the specific detail called for will appear as a part of some more general heading. There may also be an unwillingness, in some corporations, to make so full an expose of their affairs as the formula calls for. From these causes the statements may not be as complete as could be wished, especially with regard to past operations. But, if imperfect, they will still be valuable to the extent to which they may reach, and should the form of record, now recommended, be approved of, they will for the *future* be as ample as is desired.

Knowing that you already appreciate fully the importance of this measure, and will not be backward in forwarding it, I now leave it in your hands, and remain, very respectfully, your obedient servant,

Baltimore, December, 1843. BENJ. H. LATROBE, *Civ. Eng.*

COLUMBIA AND PHILADELPHIA RAILROAD.

The following statement, from the Weschester, Penn., Republican, and Democrat, gives a more favorable account of the management of this road than we have before seen; and it, at the same time, establishes, beyond a doubt, the fact often asserted, that there has been *gross mismanagement* of its affairs, if not the most barefaced robbery of its funds, by those who have had the control of it. This statement shows a *daily* saving in the *motive* power alone, for a continuous period of *twenty-one* months, of $409 33, or $261,440 27, when compared with its management from February 6, 1839, to February 28, 1842, a little over three years.

We would not be understood as intimating that the whole of this enormous difference between $760 18, the average daily expense from 1839 to 1842, and $250 88, the average daily expenses of the past twenty-one months, was misappropriated. There have been, or *should* have been, important lessons learned in the economy of managing railroads and their machinery, within the last five years, as we find by the annual reports of the different companies; not, however, in the ratio exhibited in this statement—yet it establishes the correctness of our theory, that it is *true* economy to employ, and pay *liberally*, none but men of *proved* integrity, and unyielding energy in the management of all public works—sycophants, *time*-servers and politicians *never*. Will not States and companies learn wisdom?

"Some time since, we requested of Mr. Morehead, the superintendant of this branch of the public works, that, at the close of the financial year, he would furnish us with an abstract from his annual report, showing the receipts and expenditures for the past year. In compliance with that request, he has communicated the following statement, which, with his accompanying remarks, cannot fail to be highly interesting and gratifying to every Pennsylvanian:

ABSTRACT STATEMENT,

Showing the total receipts and expenses on the Columbia and Philadelphia railroad, from December 1st, 1842, to November 30th, 1843—one year.

PROPOSED FORM

CHARACTER AND DESCRIPTION OF THE RAILROAD.

DISTANCES.			HEIGHTS.		
Length in miles and decimals, of main stem between termini.	Length of branches, in miles.	Length of single track in miles.	Total ascents and desc'nts in feet.	Height in feet of one terminus above the other.	Leng in mi & de mals, grad unde 10 f pr mi

COST OF CONSTRUCTION, OR CAPITAL INVESTED IN THE WORK.

GRADUATION.			
Cubic yards of earth.	Cost of earth work.	cubic yards of rock and tunneling.	Cost of rock wor and tunneling

WATER-STATIONS.		BUILDI			
		Station houses.		Engine and houses.	
No.	Cost.	No.	Cost.	No.	Co

OPERATION OF THE ROAD, *viz:* WORK DONE, RECEIPTS AND EXPENSES, PROFITS AND DIVIDENDS.

EXPENSES.	Repairs and renewals of engines and tenders	C w

REPAIRS	
Passenger cars.	Bur car

RECE			
For transportation of passengers.	For transportation of tonnage.	For carrying mails.	Fro Pass

NOTES. — Descriptive of the plan of the Bridges. The
The number, causes, extent and pecuniary amou
with any other particulars that may be of intere

PROPOSED FORM OF TABULAR STATEMENT DESIGNED TO EXHIBIT ANNU

gth f gle ck n es.	HEIGHTS. Total ascents and desc'nts in feet.	Height in feet of one termi-nus above the other.	GRADES. Length in miles & deci-mals, of grades under 10 feet pr mile.	Do. b'tween 10 & 20 do.	Do. b'tween 20 & 30 do.	Do. b'tween 30 & 40 do.	Do. b'tween 40 & 50 do.	Do. b'tween 50 & 60 do.	Do. b'tween 60 & 70 do.	Do. b'tween 70 & 80 do.	Do. b'tween 80 & 90 do.	Do. b'tween 90 & 100 do.	Leng & in nat'n high grad in fe pr mi

GRADUATION				MASONRY.					
k.	cubic yards of rock and tunneling.	Cost of rock work and tunneling.	TOTAL cost of Graduation.	No. of bridges arched with stone or wood	Perches of bridge masonry.	Cost of bridge masonry.	No. of square culv'rts or drains.	Perches of culvert or drain and dry wall masonry.	Cost o culvert a dry wa masonr

BUILDINGS.					REAL ESTATE, viz: depot ground.		RIGHT OF WAY, fencing and damages.			
ion houses.		Engine and car houses.		Work shops.	No. of acres of ground	Cost.	No. of acres of land.	Cost.	Locomotive tenders	
Cost.	No.	Cost.	No.	Cost.					No.	Co

MOTIVE POWER.								
Repairs and renewals of engines and tenders	FUEL.				Oil for engines and tenders.	Cotton waste for engines & tenders.	Tools for engn's and tenders.	e
	Cords of wood.	Cost.	Tons of coal or coke.	Cost.				

REPAIRS OF CARS.						
Passenger cars.	Burthen cars.	TOTAL.	Repairs of depots.	Repairs of water stations.	Watching wooden bridges.	Pumping water.

RECEIPTS OR GROSS REVENUE.								
or rtation nage.	For carrying mails.	From other Railroads for carrying.		Tolls for use of road by cars of other roads.	Tolls for use of cars by other roads.	Revenue from all other sources.	TOTAL Revenue.	Miles pass eng
		Passengers.	Tonnage.					

of the Bridges. The number, dimensions and plan of the Tunnels, if any. The number, length an xtent and pecuniary amount of damage to road and machinery from Accidents, within the year. Also. a lars that may be of interest to the public.

EMENT DESIGNED TO EXHIBIT ANNUALLY THE STATISTICS OF THE SEVERAL RAILR

GRADES.

Do.	Do.	Do.	Do.	Do.	Do.	Length & inclination of highest grade in feet pr mile.
tween 0 & 50 do.	b'tween 50 & 60 do.	b'tween 60 & 70 do.	b'tween 70 & 80 do.	b'tween 80 & 90 do.	b'tween 90 & 100 do.	

CURVES.

Length in miles & decimals, of curves under 500 feet radius.	Do. from 500 to 1000	Do. from 1000 to 2000	Do. from 2000 to 3000	Do. from 3000 to 4000	Do. from 4000 to 5000	Do. over 5000 feet radius.	Length of straight line in miles and decimals

MASONRY.

Perches of bridge masonry.	Cost of bridge masonry.	No. of square culv'tts or drains.	Perches of culvert or drain and dry wall masonry.	Cost of culvert and dry wall masonry.	Total cost of masonry.

WOODEN BRIDGING.

No. of wooden superstructures.	Least and great'st span in feet.	Total No of linear feet in superstructures.	Total cost of superstructures.	Cost of cross-tie timbers

AL ESTATE, RIGHT OF WAY, depot ground. fencing and damages.

of s	Cost.	No. of acres of land.	Cost.
nd			

MACHINERY.

Locomotives and tenders.		Passenger cars.		Burthen cars.		Horses and harness.	
No	Cost.	No	Cost.	No	Cost.	No.	Cost.

ENG

Prelimi surve and locatio

MOTIVE POWER.

of or .	Cost.	Oil for engines and tenders.	Cotton waste for engines & tenders.	Tools for engn's and tenders.	Wages of enginemen and firemen.	Horse power in streets.	Total cost of motive power.

Graduation, viz. ditching, removing slips and rising embankments.	BRI Stone or Brick.

Repairs of depots.	Repairs of water stations.	Watching wooden bridges.	Pumping water.	Oil and grease for cars.

SALARIES AND WAGES

General superintendant, agents and clerks.	Conductors and brakemen of passenger cars.	Conductors and brakemen of burthen cars.	Labor horse p at depot

NUE.

r ad ds.	Tolls for use of cars by other roads.	Revenue from all other sources.	Total Revenue.

WORK DONE BY THE ROAD.

Miles run by passenger engines.	Miles run by tonnage engines.	Passengers carried one mile.	Tons of freight carried one mile.	Tons of fuel & materials on company's own account carried one mile.

of the Tunnels, if any. The number, length and annual cost of working Ferries, if any. The plan and weight hinery from Accidents, within the year. Also, a Tariff of the existing rates of Toll on Freight and Passeng ers, and

ES.			RAILWAY TRACK.											
	Do.	Do.	Length of straight line in miles and decimals.	Length and radius of shortest curve.	Highest grade occurring on shortest curve.	Width of road-bed, average for cuts and fills.	Form of cross section of iron rail.	Weig't of rail in tons per mile.	Weig't of fastenings of rail in tons per mile.	Number and sizes of cross-ties per mile.	Number of feet board measure of longitudinal timbers per mile.	Perches (of 25 cub. ft.) of gravel or broken stone filling per mile.	Gauge or width of track between rails, in feet and inches.
n 0 0	from 4000 to 5000	over 5000 feet radius.											

RIDGING.		RAILWAY TRACK.							
No near ı su- ruc- es.	Total cost of superstructures.	Cost of cross-tie timbers.	Cost of longitudinal timbers.	Cost of iron rails.	Cost of fastenings of rails.	Cost of gravel or broken stone ballasting.	Cost of workmanship and labor.	Turntables, switches and contingencies.	Total cost of tracks.

	Horses and harness.		ENGINEERING.		General and contingent expenses under all other heads.	Total cost of work to date.	Amount of capital stock.	Amount of loans.
	No.	Cost.	Preliminary surveys and location.	Superintendance of construction.				

REPAIRS OF ROAD.

Graduation, viz. ditching, remov'g slips and raising embankments.	BRIDGES.		RAILWAY TRACKS.					
	Stone or Brick.	Wood.	Timber.	Stone.	Iron rails.	Fastenings.	Workmanship.	Contingencies.

AND WAGES			Conting't expenses of transportation.	GENERAL EXPENSES.				Total expense of working the road.
s en er	Conductors and brakemen of burthen cars.	Labor and horse power at depots.		Salaries of president, secretary, treasurer & office clerks.	Taxes on property.	Rents, insurance, law expenses.	Contingencies of all kinds.	

ROAD.		EARNINGS OF THE ROAD, or Nett Revenue.		Nett revenue from the commencement of operations.	Number of years since opening of road.	LEGAL RATES OF TOLL.	
ons of freight carried one mile.	Tons of fuel & materials on company's own account carried one mile.	Clear Receipts.	Per cent. dividend for the year.			Per passenger per mile.	Per ton per mile.

The plan and weight of the Engines and Cars. Relative amount of Trade and Travel in each direction.
reight and Passeng ers, and a statement of the number of Tons carried one mile, of each description of Tonnage;—

RECEIPTS.

Amount of road tolls collected, as per reports of collectors,		$199,274 51
Amount of motive power toll,		190,510 85
Amount due from post office department, for carrying United States mail,		2,733 33
Amount received for rents, and old materials sold,		2,173 48
		$294,692 17

EXPENSES.

For repairs of road, from Dec. 1st, 1842, to Nov. 30th, 1843,	55,082 09	
For maintenance of motive power during the same time,	135,292 99	190,375 08
Excess of receipts over all expenses, for the year 1843,		204,317 09
To which may be properly added the difference in value of stock in the motive power department, Dec. 1st, 1842, in favor of Dec. 1st, 1843,		9,481 38
Nett profit,		$213,798 47

"*Messrs. Price & Strickland*—The above statement may be relied on as strictly correct. The expenses of the year are greater than was antioipated; principally owing to the increased amount of business done this year, but which does not show a corresponding increase of receipts, in consequenee of a reduction of tolls made by the canal commissioners, equal to about 30 per cent. on the whole business done. In addition to this, the expense of maintaining the State trucks to carry section boats over the road, the fixtures necessary to transfer them to and from the railroad and canal at Columbia, (which cost about 4,000 dollars,) are all included in the above expenses of motive power and repairs.

"It will be a matter of great gratification to the tax-burdened citizens of our Commonwealth, to learn that our public works are capable of producing a revenue equal to the cost of repairs and management, and the interest on the cost of construction. I confidently believe, so far as the Columbia and Philadelphia railroad is concerned, that, with proper management, no tax will be necessary to pay any portion of the interest on its cost, much less to pay the expenses of management. Yours, etc., "J. B. MOORHEAD, *Sup't.*"

We cannot permit the preceding statement to go, by itself, before the public, although in and by itself, it is entirely satisfactory. It is due, however, to the people at large, to the public interest and to justice, as well as by way of encouragement to faithfulness to duty, on the part of those engaged in the management of the State improvements, that a comparison between past and present management on this railroad should should be made. That comparison is exhibited in the following statement, based upon information derived from official sources, and others, in which, we believe confidence may be reposed.

STATEMENT.

Comparing the expenses of motive power, from Feb. 6th, 1839, to Feb. 28th, 1842; with the expenses from March 1st, 1842, to Dec. 1st, 1843.

Expenses settled in auditor general's office, up to March 31st, 1843, contracted under the superintendency of Jas. Cameron and Thos. Tustin. See Senate Journal, page 291,	$810,154 43
Expenses settled since that time by present superintendent, under present creditor law,	17,708 28
Expenses paid since that time, by present superintendant,	21,260 62
Total expenses of motive power for 3 years and 22 days, as far as settled,	$849,122 33

Expenses from March 1st, 1842, to Nov. 30th, 1843, settled in auditor genenal's office,	$216,070 83	
Liabilities contracted during same time, and unpaid,	8,496 65	
Total expenses for one year and nine months,		$224,567 48
Average expenses per day, from Feb. 6th, 1839, to March 1st, 1842,		760 18
Average expense per day, from March 1st, 1842, to Nov 30th, 1843,		350 88
Difference per annum in favor of present management,		$149,394 50
Difference per month in favor of do.,		12,449 54
Difference per day in favor of do.,		409 30

For the American Railroad Journal and Mechanics' Magazine.

DURATION OF RAILROAD IRON—REMARKS ON MR. C. ELLET'S FORMULA.

I have noticed, with much surprise, that neither your valuable Journal—the Journal of the Franklin Institute—or any of our engineers, have yet questioned the formula of Mr. C. Ellet, in the position he assumes, viz, *that no flat bar railway can transport over it to exceed* 150,000 *tons, without the iron rails being crushed—destroyed*, and that even with the best T rails, such as are used on the Philadelphia and Reading railroad, he doubts their capacity to sustain the traffic of 800,000 tons without the necessity of their entire renewal. He uses the following language:

"The rails of the Reading road are, by common consent, acknowledged to be good; the pattern is considered, by the advocates of edge rails, to be unexceptionable; and the mode of manufacture adopted—that of making the lamina horizontal—is considered to render them almost proof against wear.
"In regard to these rails—with all their merits, and all their superiority—I affirm,
"1st. That they will not withstand the rolling of the trade of the Schuylkill for one year.
"2nd. That before 800,000 tons of coal have passed down and the empty cars have been returned on them, the present track will be entirely unfit for safe usage."

Perhaps our vision may be obscure from having taken up the opinion, some years back, that railways, such as the Reading, or a road to be located on a descending line from Buffalo to the Hudson, were destined to supercede—if not materially relieve—the profitable canals to which these lines are parallel, from the plethora of their increasing business.

In this State, the canal interests have "*black balled*" railways in legislative reports, and have stifled all inquiry into their merits, compared with canals. As we have a great respect for Mr. Ellet's talents, we would not wish to charge on him that the Schuylkill canal atmosphere of Philadelphia may have led him to view the cause of railways in the desponding vein he treats the success of the Reading railroad. If his positions be true, the capitalists of England, who have invested upwards of $250,000,000 in 1500 miles of road, and those of this country $100,000,000 in 400 miles completed have committed sad blunders. If Mr. E. is correct, in "using up" the flat bar after 150,000 tons has passed over it, or the *edge* with 800,000 tons, the sooner we burn up our rails, and send the iron to the blacksmith the better. The doctrine of Mr. E. goes to prove, that the more business done on railways, the worse they are off, while he roundly asserts that one year's business of the Erie canal, or of the Schuylkill canal, would annihilate the Reading railroad. It would appear, however, that while the Schuylkill canal,

during the last year, brought down from the mines 447,050 tons, the Reading railroad, with a deficient motive power, and cars, added to an insufficiency of double track in the centre, carried over it 229,015 tons—we, therefore, venture little in predicting, that ere two years, 800,000 tons will have passed over it, without any serious injury to the iron rail, and disprove Mr. Ellet's assertion of the durability of this road.

We draw this conclusion, from the fact presented in the "*Report of the managers of the Delaware and Hudson canal company to the stockholders,*" published 7th of March, 1843, and circulated in Philadelphia, that over the $\frac{4}{5}$ to $\frac{4}{8}$ flat bar railroad, that connects this canal with the Lackawana coal region, there has been transported, without renewal, since it was laid down, in 1829, 1,627,250 tons.

We have not received the returns for 1843, from the Mauch Chunk and Lehigh railroad, but placing the quantity transported in 1843 at the same rate as 1842, we have since 1828, (when the light flat bar was laid down,) 1,794,611 tons carried over this road.

As Mr. E. calls for *facts* of the capacity and durability of iron rails, we would refer him to the Stockton and Darlington railroad, built expressly to transport coal, where stationary power is used, and the grades are fifty feet to the mile, and the load 65 tons. In a report prepared from parliamentary documents—quoted in "Sketch of a railway," p. 58—we find that the Stockton and Darlington railroad has taken 690,000 tons and 200,000 passengers, or upwards of 700,000 tons in one year, an amount nearly equal to the destruction of the Reading railroad, according to the theory of Mr. E. We believe it is now more than ten years this road has exceeded the average of 600,000 tons per annum.

But we have a stronger fact in De Pambour, (appendix, page 288,) that certainly should have been before Mr. E. We allude to the experiment on the Liverpool and Manchester railway, where "a flat iron bar was laid down the 10th May, 1831, weighing 177 lbs. 10½ oz.. It was taken up the 10th February, 1833, after having passed over it 600,000 tons. Its loss was 18½ oz. or only $\frac{1}{115}$ of its primitive weight." At this rate, it would require, according to the language of De Pambour, "100 years to reduce it half its original strength."

With these facts, we shall leave Mr. E. to sustain his formula with his brother engineers and the public. We cannot, however, close these hasty remarks, without returning Mr. E. our sincere thanks for the research and classification of the several items of cost of motive power on railways, derived from the meagre reports that have heretofore been so common, even when prepared by legislative requirement. J. E. B.

For the American Railroad Journal and Mechanics' Magazine.

WEAR OF IRON RAILS.

In Mr. Ellet's paper on this important subject, there are one or two omis-

sions which I find it difficult to account for. In the first place, there is no allusion to one of the oldest railways in the Union, and in the State of Pennsylvania too, over which had passed during late years about 200,000 tons per annum; and during the 12 or 14 years of its operation, at least 1,500,000 tons must have passed over this thin plate rail. The railway connecting the Delaware and Hudson canal with the mines, is the road referred to. If it be objected, that steam power is not used on this road, and, consequently, that it does not come within the rule, it must be admitted that the wear from the engine alone is more than ten times that of the freight; for Mr. Ellet says,

"The common half inch flat bar, under ordinary circumstances, is adequate to the transportation of about 150,000 tons of freight."

This is, of course, entirely out of the question.

In speaking of the South Carolina road, the iron is said to have been "destroyed." (page. 359) Had it been stated how many pounds per yard it had lost, or that it had been crushed or broken, some engineering information would have been given. But, unless my memory fail me, this iron was not only not destroyed, but was sold for a large sum, the company desiring a heavier rail for the increased business which was expected from the—at that time—contemplated extension of their road. Not having the official documents, I am unable to state the exact number of tons which have passed over the thin plate rail of the road first referred to, nor the amount which the "destroyed" rails of the South Carolina road brought in, with the price of iron at that time. Unless given by some other correspondent, I will endeavor to ascrtain the "actual" loss in the South Carolina road.

The mere fact that the rails on the Lowell, Camden and Liverpool railways have been changed, however important in itself, gives not the slightest information as to the absolute wear of rails; and it is worthy of remark that these changes have been most frequent on the most flourishing railways.

"In England, however, it is contended, people have more experience. The best experience there, is that of the Liverpool and Manchester railroad, a work which was opened to public use in the fall of 1830."

Here again the "par excellence" freight road of that country, the experience of which is worth more than that of all the other railways, perhaps in the world, is unaccountably passed by. The freight passing on this road is about equal to that of the Erie canal—upwards of 700,000 tons in freight and passengers per annum—and as the engines take only 65 tons per trip, the wear may be put down at twice that of a similar quantity passing over the Reading railway, where the engines convey three times as much at a trip. If the rails on the Stockton and Darlington railway are renewed every ten months, the old iron being comparatively worthless, then is Mr. Ellet's view correct. In the appendix to de Pambour it is stated:

"On May 10th, 1831, on the Liverpool line, a malleable iron rail, 15 feet long, carefully cleaned, weighed 177 lbs. 10 1-2 oz. On Feb. 10th, 1833, the same rail, taken up by Mr. J. Locke, then resident engineer on the line, and well cleaned as before, weighed 176 lbs. 8 oz. It had consequently lost in 21 months a weight of 18 1-2 oz. The number of gross tons that had passed on the rail during that time was estimated at 600,000."

Now, assuming, with Mr. Ellet, that the upper table weighs 20 lbs. per yard, it would require more than 12,000,000 of tons gross to reduce it one-

fourth in weight, on the supposition that this part of the rail is alone subject to wear.

The wear of rails has received much attention at various times, and Messrs. Knight and Latrobe introduced into their estimates of annual cost a certain amount to replace the iron rails. No particular number of tons was assumed, but, judging from the number of trips, about 4,000,000 would be a fair estimate.

I believe there are several roads with the plate rail, which have sustained the wear of 100,000 tons in freight and passengers, with a very insignificant loss in weight of iron—among the number, the South Carolina, and Hudson and Mohawk railroads. My object in writing, is, however, mainly to draw attention to the fact, that the oldest freight roads in England and the United States find no place in Mr. Ellet's paper, and that in the instance of the South Carolina road, the whole case is not stated, so that the reader is led to the most erroneous conclusions.

January, 1844. W. R. Casey.

Railroad Dividends.—We find in the Boston "*Shipping List*" the following statistics of the dividends of the Boston railroads for the last six months.

Roads.	Amount of Capital.	Amount of Dividends.	Dividends per Share.	Current Prices.
Lowell,	$1,800,000	$72,000	$4	$130
Worcester,	2,700,000	81,000	3	117
Eastern,	2,200,000	66,000	3	108
Providence,	1,800,000	54,000	3	108
Boston and Maine,	1,200,000	36,000	3	107
Nashua,	400,000	16,000	4	130
New Bedford,	400,000	12,000	3	107
Taunton branch,	250,000	12,500	5	120
Charlestown branch,	250,000	7,500	3	78
	11,000,000	357,000		

PRICES OF PORK AND POULTRY IN ALBANY AND BOSTON.

The Rochester Democrat has the following remarks in relation to the relative value of pork and poultry in Boston, Albany and Rochester. It says:

"On looking over the prices of pork, in Albany and Boston, we notice they are very high, compared with the markets in western New York. The reason is, that seventy-two miles of the railroad, between Utica and Albany, that connects us with Boston, is not suffered to carry freight. This is a great detriment not only to our pork raisers and wheat growers, but to all who raise a surplus of any kind of produce. Poultry is another article which always bears a high price in New England, and while our farmers are compelled to peddle it out here at four cents a pound, it is selling in Boston at ten cents. Could this winter embargo be removed, while the canal is closed, it would add thousands of dollars to the pockets of the farmers in this section. The west has suffered long enough in this respect. Prompt action should be had, and the Utica and Schenectady railroad company should be not only empowered, but *compelled* to carry freight in the winter."

We have frequently referred to this subject before, and urged the propriety

of authorizing the Utica and Schenectady railroad to carry freight, *especially* in winter, when the canals are closed. The advantage will be mutual to the farmers, and the citizens, and not disadvantageous to the company; as during winter, the travel is much less than in summer, and the engines are seldom required to take full loads, and may always take more or less freight.

It appears to us a narrow policy to construct important works, for the benefit of the people, and then to restrict them from doing that for which alone they were chartered. Our canals and railroads were undertaken and completed for the purpose of *facilitating* and *increasing business*, to enable the farmers to send their produce to market, and the merchants their goods to the country, at cheaper rates, and the result has been all that was anticipated —and *much more*, yet *not all* that they are *capable* of accomplishing—then why not require of them to extend their operations and usefulness to their full ability. We hope the legislature will be called upon to act on this subject at their present session.

ATMOSPHERIC RAILWAYS.

We find in the November number of the Practical Mechanic and Engineers' Magazine, the following description of the atmospheric railway; from which it appears that some interesting and successful experiments have been made on the west London line, at Wormwood-scrubs, and also on the Dalkey branch of the Dublin and Kingstown railway. These experiments are not given in detail, so that we can judge accurately of the practical operation of the system, yet they are referred to in a manner evincing no doubt of their accuracy by the editor. This result is in perfect accordance with an opinion expressed to us six years ago by Mr. Samuel Blydenburg, an intelligent practical mechanic, now deceased; who spake of its practicability as beyond a question, and of its extensive introduction as certain. In this account we are told that, not only the first cost of construction, but also the cost of working the road is greatly reduced; which, if true, is certainly a strong argument in its favor; yet, a stronger one in our opinion is, its *greater safety*—a consideration altogether above dollars and cents.

We give this article entire, and shall look with interest for further accounts in relation to the progress of a system, which may, at no distant day, say to the locomotive, as it has said to that noble animal, the *horse*, "your services are no longer required on this road."

More than a year ago, we intimated our intention of bringing this scheme under review; but as time passed on, the *experimentum crucis* on the Dalkey branch of the Dublin and Kingstown railway progressed, and at length attained a state of forwardness, which induced us to await the completion of the undertaking before hazarding any prophetic opinion respecting its general practicability, and the advantages claimed for it by its advocates over the plain matter of fact modes of propulsion at present in operation on our railway lines. The experiment has now attained maturity, and has already established, beyond dispute, this one important fact—that the scheme is possible.

But before proceeding to a description of the mechanical appliances by which this consummation has been realized, it may not be out of place to ob-

serve, that the principle of the scheme possesses much less of novelty than is commonly associated with it. Even two centuries ago, the notion was entertained of producing motion economically for the purpose of transit by means of the pressure of the atmosphere. The original thought may, at least, be traced back with certainty to the celebrated Dr. Papin. In succession, long afterwards, came Lewis, Vallance, Medhurst and Pinkus, whose speculations excited in their day, some attention and more ridicule. Many of these are curious, and none of them are more absurd than that of Vallance, who actually proposed to propel his carriages and passengers through an exhausted tunnel. Medhurst, in imitation of Vallance, in his first speculation, proposed likewise to drive his carriages through a subterranean passage, but believing that his passengers could not comfortably exist without air, made provision, at least partially, for its supply during the passage. In a pamphlet which he published in 1817, he describes his line of transit as a "hollow tube" of such dimensions as to admit a four-wheeled carriage to run through it, and to be constructed air-tight of iron, brick, timber, or other "suitable material." The carriage was to be of a form and size nearly to fill the cross section of the tunnel, and to be propelled forward in one direction, by forcing air into the tunnel behind it, by means of a stationary engine, working a huge air-pump; and in the other, by exhausting the tunnel in advance of the carriage, and allowing the pressure of the atmosphere to act upon it behind. The proposal was received with ridicule, and for a season afforded good material for the caricaturist. But Mr. Medhurst was not abashed; nor was his ingenuity exhausted, for he speedily devised means of propelling his carriage in the open air, and of making a communication between the interior of his propulsion tube, and the outside, preserving it at the same time air tight. His scheme now began to assume a rational form. Its principal feature was the exchange of the subterranean tunnel for an iron pipe of 24 inches diameter, having a longitudinal opening on its underside, between two flanges of six or eight inches deep. These flanges were to be immersed in a channel of water, thus forming a species of water valve, throughout the whole length of the pipe. It is unnecessary to say, that this valve did not answer, but it was an approach which seems rather to have whetted than damped the ardor of the inventor, for he immediately discarded it for one formed on the top of the vacuum pipe. In this modification, the pipe had no flanges along the opening. The valve was a metal plate, hinged to one edge of the groove, and had some soft substance as leather, fixed upon the other edge, to shut against a seat of a similar material, fastened on the corresponding edge of the groove, so as to form when shut, an air tight joint. The power was in this case as before, to be obtained by exhausting the main by an engine at one end, and to allow the pressure of the atmosphere to act upon the back of a piston accurately fitted to the pipe, and having a projecting arm passing through the groove; to this the carriage was to be attached. The piston had certain attachments for opening the valve as it advanced, and others for shutting it; but withall the valve was not tight.

In this advanced state was the contrivance, when taken up by Mr. Penkus, who suggested the rope valve, which likewise failed to keep the tube air tight, and was in turn abandoned. The course being thus clear, and the notion reduced in some measure to a practicable form, Mr. Clegg stepped forward, and solved the difficulty. He has deviated in no respect from the general arrangement suggested by Mr. Medhurst, but by a closer attention to the conditions of the problem and the mechanical details which these involve, has succeeded in working out the original suggestion to practical util-

ity in a way which promises to be efficient, and capable of enduring the rough usage necessarily attendant on constant and rapid motion.

The atmospheric railway in its present state of development, consists of a cast iron pipe, laid in lengths, like water and gas mains, between the rails of the line, and attached to the cross sleepers which support them. On the top of this pipe is a narrow longitudinal opening, which for the purpose of rendering the pipe *pro tempore* air tight, is covered with a valve as suggested by Mr. Medhurst. This valve is a simple flap formed of a slip of leather rivetted between narrow plates of iron—the plates on the exterior side being flat, while those on the under surface are of a segmental form to complete the inner periphery of the tube when the valve is closed down. On one side the leather is fastened down to a longitudinal rib, cast along the opening in the pipe, and being flexible, forms a species of hinge. The other edge, when the valve is shut, falls within a ridge cast upon the pipe, and forms with it a channel which is filled with a composition of bees' wax and tallow. This substance when melted into the channel cements the valve in its place, rendering it to the necessary extent air tight. The tube is of the same diameter throughout, and has a piston fitted into it likewise made air tight, by leather collars. At the end of the rod of the piston is a counter weight to keep the rod, which is about fifteen feet in length, parallel to the axis of the tube. Upon this rod is also a frame which carries four wheels, the use of which is to open the valve as the piston advances in the tube. To it is also attached the *coulter*, which is formed of strong plate iron, and projects through the longitudinal opening in the pipe, forming a connection between the piston and the leading carriage or guiding truck of the train moving upon the railway. The tube being exhausted in *front* of the piston by an air pump worked by a steam engine, the piston is acted upon behind, and impelled forward by the air, which finds admission into the main by the opening of the valve on the passing of the coulter. This opening through which the coulter passes is raised only a few feet in length at a time, and *not* in advance of the piston. By the operation of raising the valve out of its seat, the packing is broken; but the air tight contact is again immediately reproduced, when the coulter has passed. The first part of this operation is effected by a wheel attached to the guiding truck, which operating by a spring, presses the valve into its place, where it is cemented by a hot copper slide, about five feet long which passing over the surface of the composition in the groove at the valve edge, renders it partially fluid. The valve being thus opened and replaced air tight as before, the tube is left ready to be again exhausted for the next train.

The main pipe is prepared inside to receive the piston in a very simple and economical manner. On the castings being taken from the foundry sand, a cutter is passed through them; this if followed by a wooden piston, which spreads the unguent in a complete coating of even interior surface. By the frequent passage of the working piston, this tallow lining, or tinning as it were, becomes perfectly smooth and nearly as hard as Paris plaster, so that the piston may be considered, practically speaking, to work in a tube of tallow protected by the iron pipe as a casing.

In this mode of propulsion, it is clear that the measure of the power for producing motion is the product of the sectional area of the main pipe multiplied by the number of pounds pressure due to the vacuum. Thus from a tube of twelve inches diameter under a vacuum of eighteen inches of mercury, giving nine pounds pressure per square inch, there is obtained an atmospheric power of fully 1000 pounds—a result equivalent to the *average adhesive* power of a locomitve engine; and capable with due deduction for

friction and resistance of all kinds, of propelling ten carriages of 46¼ tons over a horizontal railway; and two carriages of 9½ tons up an incline of so steep a gradiant as 1 in 28. On the West London line at Wormwood scrubs where the atmospheric system has been in constant and successful operation under very disadvantageous circumstances, on a length of half a mile, for the last three years, the main pipe is only nine inches diameter. Up this line, which is an incline of 1 in 120, loads of 13 tons have been propelled at the rate of 20 miles an hour. On the Dalkey branch of the Dublin and Kingstown railway, the tube is 15 inches diameter, and the gradient of the incline is 1 in 110. Up this three carriages loaded with passengers, have been propelled over a distance of 1¼ mile, at the rate of 40 miles an hour.

With regard to the velocity attainable by trains impelled by atmospheric pressure, it may be regarded as independent of load and pressure, and regulated almost entirely by the proportion between the area of the tube and that of the exhausting pump; that is, by the velocity with which the air is withdrawn from the tube by the pump; the exhausting pump piston travelling at the same speed as the piston of the steam engine which works it; that is, not exceeding three miles an hour. If the trains are required to travel at the rate of 30 miles an hour, then the transverse sectional area of the air pump must be to that of the pipe as 10 to 1, and the engine power must be provided accordingly. This is independent of load; and gravity being practically an equivalent augmentation of the load to be moved, it is consequently also independent of the gradient. In practice, atmospheric leakage must be taken into account, and additional engine power provided for it; this is computed to be at the rate of six horse power per mile of pipe.

To illustrate this still further: suppose the travelling load to be 50 tons, and the degree of vacuum necessary to obtain a given velocity, producing a pressure of 10 pounds per square inch on the piston; so long as the load is the same and the line level, the train must move with equal velocity, because the speed is due to the rapidity with which the air is pumped out of the pipe. But if the load be only 25 tons, starting with the same pressure as with 50 tons, the train then runs faster than the air is drawn out of the pipe, the power behind being so great in the first instance, as to force the load forward at an increasing rate. But the pump going slower in proportion than the train, the air gets packed as it were in front of the piston, and becoming less rarefied, must offer greater resistance; the velocity of the train, at first greatly increased, gradually diminishes, until the amount of vacuum becomes proportionate to the weight behind it: the train then goes on uniformly. Again, supposing the train to start with a load which is rather heavy for the degree of vacuum, it moves at first with less required velocity; but the air in this case being withdrawn quicker than the road follows, the vacuum becomes more and more perfect; and thus the power increasing gradually, the train increases its velocity until it becomes balanced with the vacuum. To ascend an incline, may be called equivalent to adding to the load, and to descend equal to diminishing it; when the train therefore coming to an incline, begins to ascend, its rate will gradually diminish until the power is brought up equivallent to the pressure; that is, until the exhausting pump by going faster than the train, generates a power sufficient to impel it up the ascent. In descending inclines, the trains will start with increased velocity; but the vacuum will immediately begin to diminish and reduce the effective pressure behind. The moment the train comes to the level, its velocity will begin to increase till the balance is again restored between the velocity and pressure. Messrs. Glegg and Samuda, the patentees of the atmospheric railway, purpose to work their lines generally by stationary power, erected at intervals

of four or five miles apart; and to work the different inclines by corresponding degrees of vacuum. By this means they calculate on a large saving of first cost in the construction of railways on their system, and also in their maintenance. The former of these items they estimate at about £22,000, and the latter at £1,460 per mile below the average cost of formation, and expense of working upon the locomotive system. In this, however, it must be observed, the average cost of construction is taken at £37,000 per mile, whereas some of our most important lines have been laid down for one-third less, and it has been shown by Mr. Lock, that a very important line, the Caledonian, may be made for £17,000 a mile.

The most important of the two savings claimed is that in the annual expenditure; and it must be admitted, in looking at the enormous sacrifice of power and materieal in our locomotive system, that there is much room for economy in this department. By the application of stationary power—and this, in many, if not in most cases, might be water power—on the atmospheric system there is nothing to be propelled except the carriage, and a near approximation to the full dynamical effect of the force generated is obtained. On the locomotive system, half the load on the average of trains consists of the engine and tender; and on the stationary system of traction by rope and pulley there is a large expenditure of power in draging the rope along, in bending it round the drums, working the pullies along the line, and overcoming the friction of the other parts of the attendant mechanism. On the atmospheric system, is substituted a rope of air, without friction or weight, and capable of transferring a power that may be called inexhaustible and boundless.

But on this subject we have not as yet obtained sufficient practical data to waraant a strict comparison. We know that the locomotive system is expensive in the extreme, and that the mode of traction by rope and pulley is attended with practical difficulties and inconveniences, which prevents its adoption wherever it can be avoided. A short experience on the Dalkey branch, now on the eve of being regularly opened, will decide the question to full satisfaction; we await the result with some confidence.

In conclusion, we may remark that the atmospheric system seems to hold out one paramount advantage in its perfect safety from collisions and similar accident, which on railways, even with double lines, worked by locomotive engines, are always liable to occur.

Since the above was in type, a Dublin correspondent writes that the trains on the Dalkey branch have been running regularly with perfect success, during the last three weeks, (Nov. 10th,) and that a speed of fifty miles an hour has already been obtained. So elated are the promoters of the atmospheric system, that arrangements are in course of preparation for extending the line to Bray.

The series of communications from Charles Ellet, Esq., C. E., in several of our late numbers has attracted much attention and remark. From various quarters we have been urged to make some comment upon these articles expressive of our dissent from the positions of Mr. Ellet. For several reasons we have abstained from doing so, and chiefly because—differing as he does from many, if not most of the other distinguished members of the profession—we wished that his opinions should be heard without any bias, and without any note or comment on our own part. This end has now been answered, and we feel at liberty to express our opinions with the same fredom which we have always felt disposed to grant to others.

views, no matter how warmly,—provided this is done with decency and propriety—we not only cheerfully give place to him, but *urge* a continuance —convinced that if any error is advocated, it can easily and readily be refuted by members of the profession, all of whom are welcome to our pages. Moreover, the discussion of error, if not childish or trifling in its character, is sure to end in good; and when the life and soul of the railroad system are at stake, it certainly must prove an inducement for *some one* to engage in its defence.

In several previous articles we have alluded to the manner in which this subject should be discussed, and we must confess that Mr. Ellet has approached more nearly than any one else to the spirit in which we desire to see the question taken up. We differ from Mr. Ellet, however, as to the value and correctness of his data, at least in one of the most important points —the deterioration and wear of iron. The articles of Mr Ellet show a vast deal of research, and labor; they are therefore entitled to a respectful and careful examination. But if the whole amount of railroad statistics in our possession had been used as data in the formation of the rules or formula proposed, much more general satisfaction would have been given. Fortunately, the precise and systematical method of Mr. E. allows of the readiest correction of his own errors, for such do undoubtedly exist.

The great and vital mistake, in our opinion, is the enormous, and as we imagine, unwarranted amount of deterioration assigned to railroad iron. We do not hesitate to say, that if the opinions—for they are but opinions— of Mr. Ellet are correct upon this point, the whole railroad system in this country must fall to the ground, and in Europe should by this time have already been abandoned. This is not the case, and we have from this circumstance alone a reasonable doubt as to the correctness of the position assumed by Mr. E. His data for this are taken from two roads, in themselves unfair examples, and not correctly stated. Any inference, based upon so narrow a foundation, and leading to such momentous consequences, has been well characterised by a celebrated writer as an inverted pyramid, with the apex to the ground—a fair case of unstable equilibrium.

But it is not our intention to enter into this discussion, which should be, as we have before said, based upon strict argument upon *all* the data in our possession. If the cause of railroads in general is at stake, its defence certainly must depend upon better qualified and more influential advocates than ourselves. The pages of this Journal are open to all, and we urge upon all concerned to take part in the settlement of the most important question ever presented to the profession. It is not in our power at present, even if so disposed, to fight single handed the battles of railroads in general; in this matter we feel quite independant; we are under no obligations to railroads generally, and all our labors on their behalf have hitherto been so miserably ewarded, that we think it a hard case to fight without pay and furnish our own amunition in the bargain.

We have wished to express our own individual opinion, and having so done, we open our pages to all who are disposed to enter into the argument —only asking for fair play on all sides.

RAILROAD REPORTS.

It has been a common remark by many deeply interested persons, that the *manner* in which the annual reports are made, by railroad companies, renders it all but impossible to arrive at a correct understanding of their details. There is seldom such a classification of the various items of expense as will enable an uninnitiated or unprofessional reader to arrive at the true results; consequently the great majority of the stockholders, and others who may desire to become such, are unable to judge whether it is safe for them to hold or to purchase stock in such companies. Another common remark is that there would be great convenience if the reports of all railroad companies were made, as far as possible, in tabular form,—so that the various items of expense shall always be found in every report, in the same place, and under their appropriate heads; and we speak the sentiments of thousands, when we say that much benefit will result to the cause of railroads by the adoption of a tabular form of report which shall give each item of expense under its appropriate and distinct head.

Our views upon this subject have been more than once expressed in these columns, and repeated calls have been made upon those gentlemen, whose experience in the construction and management of important lines, will enable them to draw out a form, comprising all the requisite heads, for publication in the Journal. As will be seen in this number, our call has been responded to in a manner highly gratifying to us, and we think it will be found an exceedingly comprehensive and valuable document to the profession; and we venture, in their behalf, as we do most heartily in our own, to thank Mr. Latrobe for preparing it. With this form before them, we hope each railroad company to whom it may be sent—and we shall send a copy of the Journal containing it to the president of each road, both in this country and in Europe, where we can obtain the proper direction—will adopt the form in making their reports, and send us a copy at their earliest convenience—that we may make out a general table, exhibiting at one glance, a comparative statement of the expenses on all railroads. Such a table will be useful, as it will lead to a more rigid economy, and to great reduction in many items of expense.

If desirable, we will furnish the different companies with these blanks, in such numbers as they may desire, at any time, without delay, on receiving their order, as it is stereotyped.

☞Subscribers will please recollect that this number commences a new volume; and they will do well to apply soon for missing numbers of the past volume. Those who are in arrears for subscription will relieve their own consciences, and our *necessities* by an early remittance.

ERRATUM.—Article—"Duration of railroad iron"—8th line from bottom of page, for "400 miles completed," read 4000 miles completed.

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